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SSALTO

ALGORITHM DEFINITION, ACCURACY AND SPECIFICATION VOLUME 8 : OFF LINE CONTROL PROCESSING

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ABBREVIATIONS

Sigle	Definition
ADA	Algorithm Definition and Accuracy
Adx	Applicable Document x
CAL	Calibration
CFA	Control Flag Altimeter
CLS	Collecte Localisation Satellite
CMA	Centre Multi-missions Altimètre
CNES	Centre National d'Etudes Spatiales
DAD	Dynamic Auxiliary Data
GDR	Geophysical Data Record
IGDR	Interim Geophysical Data Record
IONO	IONOspheric Data
OFL	Off- Line
ORF	Orbit Revolution File
RDx	Reference Document x

SAD	Statistic Auxiliary Data
SSALTO	Segment Sol Altimétrie et Orbitographie
SWH	Significant Wave height
TBC	To Be Confirmed
TBD	To Be Defined

APPLICABLE AND REFERENCE DOCUMENTS

Reference		Document title
SMM-ST-M-EA-10879-CN	AD1	SSALTO Product Specification – Volume 1: JASON-1 User Products
SMM-ST-M2-EA-11003-CN	AD2	Algorithm Definition, Accuracy and Specification Volume 2: CMA Altimeter Level 1B Processing
SMM-ST-M2-EA-11005-CN	AD3	Algorithm Definition, Accuracy and Specification Volume 4: CMA Altimeter Level 2 Processing
SMM-ST-M2-EA-11008-CN	AD4	Algorithm Definition, Accuracy and Specification Volume 7: CMA Near Real Time Control Processing
SMM-ST-M2-EA-11010-CN	AD5	Algorithm Definition, Accuracy and Specification Volume 9: CMA Mechanisms
SMM-ST-M2-EA-11011-CN	AD6	Algorithm Definition, Accuracy and Specification Volume 10: CMA Expertise processing
SMM-ST-M2-EA-11012-CN	AD7	Algorithm Definition, Accuracy and Specification Volume 11: CMA Visualization processing
SMM-SP-M2-EA-32012-CLS	AD8	CMA Production: Specification of the data management algorithms
SMM-SP-M2-EA-32007-CLS	AD9	Algorithm Definition, Accuracy and Specification Volume 6: Altimeter/Radiometer Verification processing
SMM-DD-M2-EA-32037-CLS	AD10	CMA production : Internal Interfaces
TP-NT-613-697-CLS	RD1	Etat des lieux des contrôles sur POSEIDON1

TBC AND TBD LIST

TBC/TBD	Paragraph	Brief description
TBD	3.3	Reference of the document that describes the generation of the external “LTM” file.

CONTENTS

1. INTRODUCTION

This document is aimed at defining and at specifying the functions of the control processing for the Off Line products. The missions concerned are JASON-1 and ENVISAT.

The algorithms of the Off Line control processing are defined in order to be used for several kinds of parameters. These parameters can be either parameters of the altimeter of JASON-1 or ENVISAT (Level 1b or 2), or parameters of the radiometer of Jason-1, or ionospheric parameters, or calibration parameters of JASON-1. For the altimeters level 1b and 2 and for the radiometer of Jason-1, all the parameters (1Hz) that are computed in the corresponding chains and that are written in an external output product have to be controlled.

The algorithms used to generate the “Long Term Monitoring” calibration parameters from calibration parameters of JASON-1 are also described in this document.

The algorithms used to control the DORIS TEC parameters are also described in this document.

All the controls are operated on a data flow except the generation of the LTM parameters which is performed on one day flow data.

The phase of control processing begins automatically after the computation of the parameters. The data flow considered is the same as the flow just computed. The results of the verification processing (AD9) will control the output products (by _ orbits and cycle for the IGDR and GDR) and will condition the distribution of the data products.

The definitions and specifications of the Off Line control processing are derived from the specifications of the corresponding POSEIDON-1 processing (RD1), accounting for the evolution of POSEIDON-2 with respect to POSEIDON-1 (AD2).

The visualization process of the controlled parameters is described in AD7.

Definition of the Off Line control processing

The definition of the Off Line control processing consists of the identification and the description of the main functions. It will provide the reader with an overview of the processing and a global understanding of the algorithms.

Specification of the Off Line control processing

Regarding the specifications of the Off Line control processing, two kinds of algorithms are distinguished:

- The “scientific” algorithms, which represent the core of the processing
- The other algorithms, which will be called the “data management algorithms”, ensuring functions such as:
  - To get the input data
  - To prepare the data to be processed

- To perform unit conversions or changes of reference systems
- To perform general checks (relative for example to the presence of input files, to the data conformity or to the compatibility of input data with the data set to be processed)
- To build the output product(s)
- To manage the processing

The “scientific” algorithms are specified in this document or specified as mechanisms (AD5), while the “data management algorithms”, which strongly depend on the format of the input and output data, are specified in AD8. The complete set of specifications (to be associated to the corresponding interfaces documents) are intended for the team in charge of the software development.

Most of the algorithms used in the Off Line control processing can be seen as mechanisms and are defined in AD5. The algorithms described in this document can be considered as a baseline. Most of them are also used in the Near Real Time Control Processing (AD4) and in the Verification Processing (AD9).

Organization of the document

- The interfaces of the processing (input and output data) are defined in section 2.
- An overview of the processing is given in section 3. It consists of the presentation of the general flowchart, and of a brief description of IGDR and GDR products control. The generation of the “LTM Calibration File” is also described in section 3.
- The detailed description of the algorithms is finally given in section 4.

  For the Off Line control processing, the description consists in:

  - An overview of the overall processing (list of functions).
  - The definition and the specification of the algorithms, using the following items:
    - Name and identifier of the algorithm
    - Heritage
    - Function
    - Applicability to the various processing procedures
    - Algorithm definition:
      - Input data
      - Output data
      - Mathematical statement
    - Algorithm specification:
      - Input data
      - Output data
      - Processing
    - Accuracy (if any)
    - Comments (if any)
    - References (if any)

The general information required for a global understanding of the algorithm within the overall processing is provided in the “Algorithm definition” sections.

The detailed information required by the team in charge of the software development is provided in the “Algorithm specification” sections, which precisely define the scientific part (i.e. the core) of the algorithms.

Basic rules

The following basic rules relative to the specification of the algorithms are applied:

- Elementary functions that are common to several algorithms (also called “mechanisms”) are specified in AD5.
- The input and output data are always identified by a precise description, an explicit name (that may be used in the coding phase), a unit and if necessary a reference system.
- Regarding the errors that may occur during the processing (for example, negative argument for logarithmic or square root functions), the algorithms systematically output an execution status. The building and the management of this information will be defined during the architectural design of the software.
- Regarding the representation of tables, the following conventions are used:
  - $X[N_1:N_2]$ represents a one-dimension table whose elements are $X(i)$ (or X_i) with $i \in [N_1, N_2]$
  - $X[N_1:N_2][M_1:M_2]$ represents a two-dimension table whose elements are $X(i,j)$ (or X_{ij}) with $i \in [N_1,N_2]$ and $j \in [M_1,M_2]$
  - And so on

2. INPUT AND OUTPUT DATA

2.1. INPUT DATA

Input data consist of three types of data:

- Product data, which may be:
  - level 1b altimeter and radiometer parameters for JASON-1 and ENVISAT
  - level 2 altimeter parameters for JASON-1 and ENVISAT
  - level 2 radiometer parameters for JASON-1
  - calibration parameters for JASON-1
  - DORIS TEC parameters
- Dynamic auxiliary data: None
- Static auxiliary data:
  - List of thresholds, processing parameters, universal constant data.

It is assumed that the level 1.0 is controlled by the CCI.

2.2. OUTPUT DATA

Output data consist of three types of data:

- altimeter or radiometer control flags
- editing reports
- averaged calibration data for LTM

2.3. SUMMARY OF THE INTERFACES

The interfaces of the control processing are summed up in **Figure 1**.

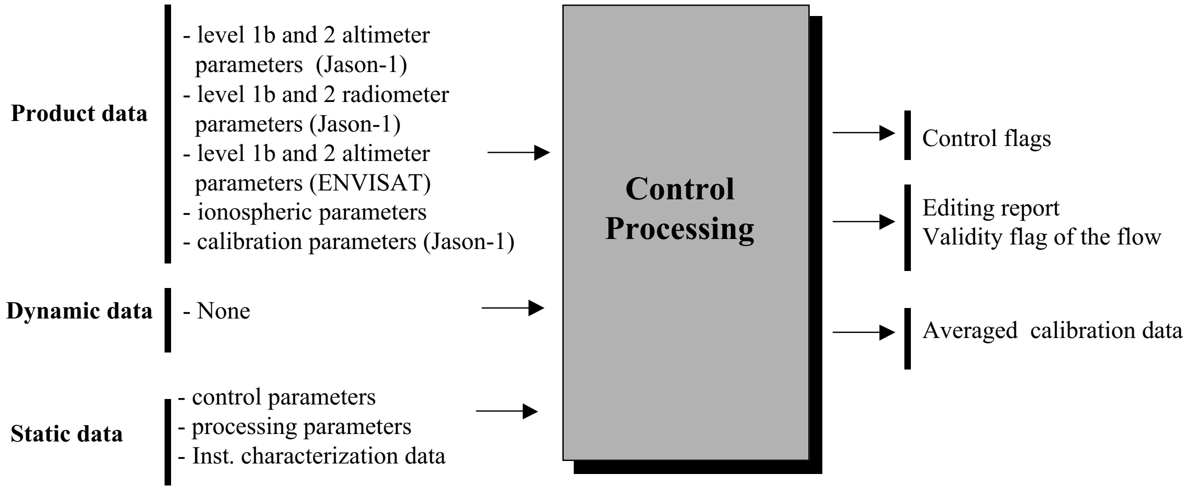


Figure 1: Interfaces of the Off-line Level 1b, Level 2 control processing

3. OVERVIEW

3.1. GENERAL DESCRIPTION

The algorithms used in the control processing can be split in two groups:

- algorithms used for the control of the produced parameters (for example 1 Hz parameters or calibration parameters)
- algorithms used for the computation of the calibration parameters for the LTM calibration file

For the part of the Off Line control processing aimed at controlling the 1Hz parameters of the (I)GDR products, the control is performed on the “ocean” data for JASON-1 and on the “ocean + continental ice” data for Envisat.

3.2. CONTROL OF THE PRODUCED PARAMETERS

The aim of the control processing for the produced parameters is to:

- detect the outliers with respect to predefined thresholds that are given in the control parameters files
- generate a set of quality flags for the computed parameters
- determine statistical characteristics of the parameters (mean, standard deviation)
- generate quality flags for the data flow

As already stated, the following types of parameters are to be controlled:

- IGDR and GDR (1 Hz) parameters for Jason-1 and ENVISAT
- DORIS ionospheric parameters
- Calibration parameters for Jason-1

3.2.1. BASIS OF CONTROL FLAG GENERATION

The data flow in input of the control processing consists of N measurements (measurements can be at the rhythm of 1 Hz for the IGDR or GDR parameters or at a very slower rhythm for the calibration parameters). Each of these measurements contains several fields that can be grouped in families. For example, the IGDR (Jason or ENVISAT) parameters can be split in several families like “altimeter range”, ”altimeter range corrections”, “Significant waveheight”…. These families are listed in the following of the document.

The control consists in several algorithms:

- 1st algorithm: setting flags by comparison with predefined thresholds (field or combination of fields can be checked). This phase is aimed at generating a validity flag (2 states: “valid” or “invalid”) for each field (or combination of fields) of each measurement of the flow depending on the result of the comparison of the measurement with predefined thresholds. This procedure is performed using the algorithm “GEN_CTL_QUA_05 - To edit data measurements using thresholds”.

- 2nd algorithm: computing a “family flag” taking into account the flags of all fields in the family.
  - If the flags of all the fields of the family are “valid”, the family flag is set to “valid”.
  - If the flag (at least) of one field of the family is “invalid”, the family flag is set to “invalid”.

  This computation is performed using the algorithm “GEN_CTL_QUA_01 - To compress an array of flags”.

- 3rd algorithm: a “general” flag is computed taking into account the flags of all families (for each measurement).
  - If the flags of all the families are “valid”, the total flag is set to “valid”.
  - If the flag (at least) of one family is “invalid”, the total flag is set to “invalid”.

  This computation is performed using the algorithm “ GEN_CTL_QUA_01 - To compress an array of flags”.

- 4th algorithm: counting the "valid" and "invalid" data measurements. The percentages of valid and invalid data on the flow are then computed.

  This computation is performed using the algorithm " GEN_CTL_QUA_03 - To determine percentages".

Figure 2 sums up the whole flags management in the control processing of the produced parameters. "Valid" flags are set to "0" and "Invalid" flags are set to "1".

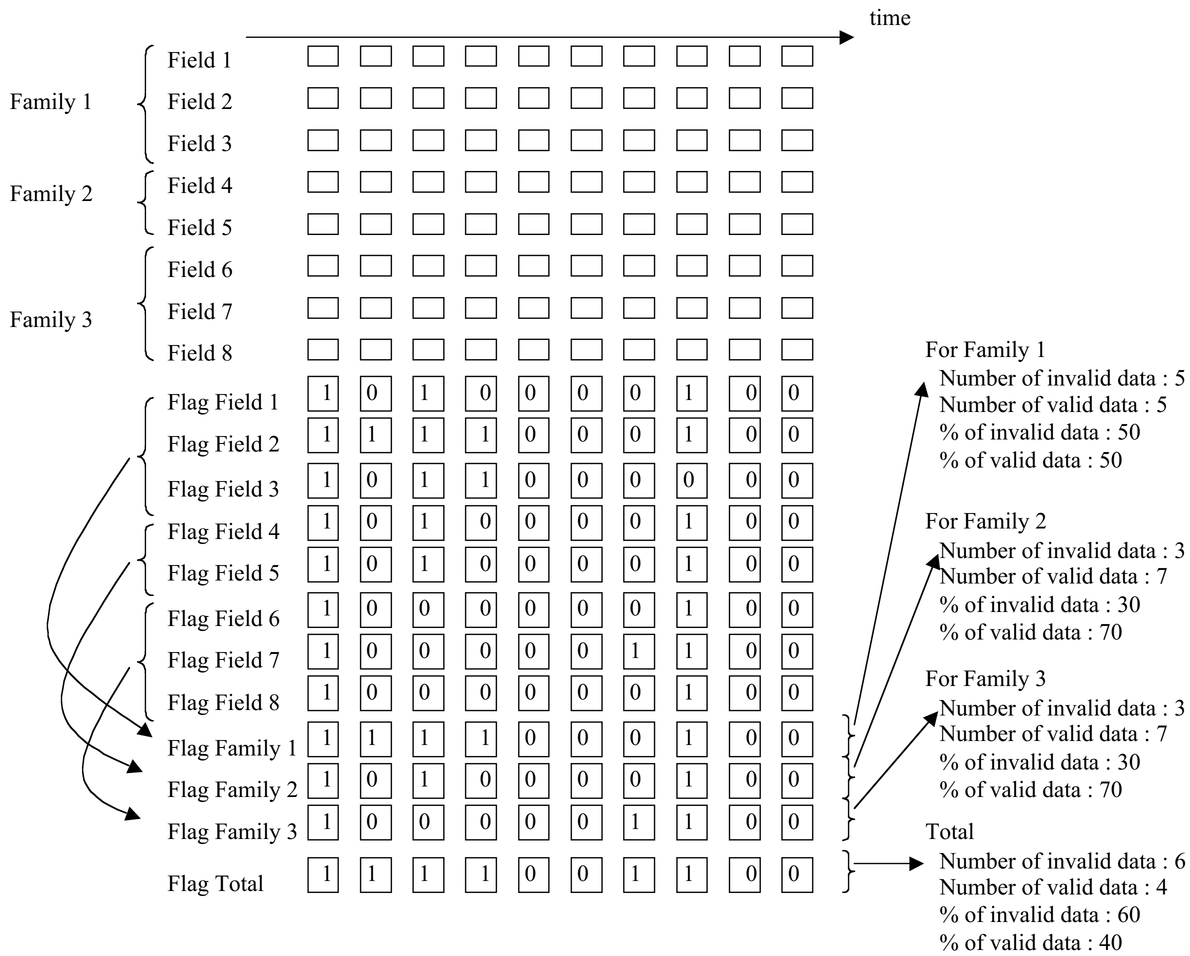


Figure 2: flags management

Depending on the types of parameters to be controlled, other specific controls are added in the following sections.

By definition, the control processing doesn't consider the following type of control:

- "Production flags" generated by the production processing are not described in this document but are described in the production algorithms at different levels (1.0, 1b, 2).

3.2.2. CONTROL OF THE IGDR AND GDR (1 HZ) PARAMETERS FOR JASON-1 AND ENVISAT

For these parameters, the control is performed on the "ocean" data for JASON-1 and on the "ocean + continental ice" data for ENVISAT. In input, each measurement has an "over-flown surface flag" that has been determined by the level 1b processing.

All the 1 Hz parameters (or combination of parameters) that are written in an external output product are likely to be controlled using one or several of the algorithms that have been described in the previous section.

The 1st, 2nd, 3rd and 4th algorithms are used.

If the percentage of "valid" data obtained by the 4th step is greater (or equal to) than a predefined value, the flow is declared "OK" and the general validity flag of this flow is set to "valid". If the percentage of "valid" data obtained by the 4th step is smaller than a predefined value, the flow is declared "NOK" and the general validity flag of this flow is set to "invalid".

For Jason, the IGDR and GDR parameters can be split in families: "altimeter range", "altimeter range corrections", "significant waveheight", "significant waveheight corrections", "backscatter coefficient", "backscatter coefficient corrections", "off nadir angle", "brightness temperatures", "geophysical parameters".

For Envisat, the IGDR and GDR parameters can be split in families: "altimeter range", "altimeter range corrections", "significant waveheight", "backscatter coefficient", "backscatter coefficient corrections", "off nadir angle", "brightness temperatures", "geophysical parameters".

The following table gives the list of parameters that can be controlled. The algorithm(s) that product(s) the parameter is identified in the third column. These algorithms are defined and specified in the following references depending if they are part of the level1b (AD2) or part of the level2 (AD3). Several (1, 2 or 3) algorithms can generate the same parameter depending on the activated product chain (IGDR or GDR) and depending on the mission (J1 or E1) but for a given chain, only one algorithm is used to product one parameter.

Field Number	Parameter	Algorithm(s)
1	Range_Main (J1,E1) (1)	ALT_COR_RAN_08 (J1,IGDR) or ALT_COR_RAN_09 (J1,GDR) or ALT_COM_RAN_05 (E1)
2	RMS_Range_Main (J1,E1)	ALT_COM_RAN_05 (J1,E1)
3	NVP_Range_Main (J1,E1)	ALT_COM_RAN_05 (J1,E1)
4	Corr_Inst_Range_Main (J1) (3)	ALT_MAN_COR_01 (J1, IGDR) or ALT_MAN_COR_03 (J1,GDR)
5	Iono_Corr_Main (J1,E1)	ALT_COR_RAN_12

6	Doris_Iono_Corr_Main (E1)	GEN_COR_RAN_03
7	Model_Iono_Corr_Main (E1)	GEN_COR_RAN_02 (E1)
8	Sea_State_Bias_Corr_Main (J1,E1)	ALT_COR_RAN_10
9	Range_Aux (J1,E1) (2)	ALT_COR_RAN_08 (J1,IGDR) or ALT_COR_RAN_09 (J1,GDR) or ALT_COM_RAN_05 (E1)
10	RMS_Range_Aux (J1,E1)	ALT_COM_RAN_05 (J1,E1)
11	NVP_Range_Aux (J1,E1)	ALT_COM_RAN_05 (J1,E1)
12	Corr_Inst_Range_Aux (J1) (4)	ALT_MAN_COR_01 (J1,IGDR) or ALT_MAN_COR_03 (J1,GDR)
13	Iono_Corr_Aux (J1,E1)	ALT_COR_RAN_12
14	Doris_Iono_Corr_Aux (J1,E1)	GEN_COR_RAN_03
15	Model_Iono_Corr_Aux (E1)	GEN_COR_RAN_02
16	Sea_State_Bias_Corr_Aux(J1,E1)	ALT_COR_RAN_10
17	Model_Dry_Trop_Corr (J1,E1)	GEN_COR_RAN_01
18	Model_Wet_Trop_Corr (J1,E1)	GEN_COR_RAN_01
19	Rad_Wet_Trop_Corr (J1,E1)	RAD_PHY_GEN_01 (J1) or RAD_PHY_GEN_02 (E1)
20	Comp_Sea_State_Bias_Corr (J1)	ALT_COR_RAN_11 (J1)
21	SWH_Main (J1,E1) (5)	ALT_COR_SWH_02 (J1,IGDR) or ALT_COM_SWH_01 (E1)
22	RMS_SWH_Main (J1,E1)	ALT_COM_SWH_02 (J1) or ALT_COM_SWH_01 (E1)
23	NVP_SWH_Main (J1,E1)	ALT_COM_SWH_02 (J1) or ALT_COM_SWH_01 (E1)
24	Elevation_Echoing_Point (E1)	ALT_COM_RAN_06
25	Net_Inst_Corr_SWH_Main (J1) (6)	ALT_MAN_COR_01 (J1,IGDR)
26	SWH_Aux (J1,E1) (7)	ALT_COR_SWH_02 (J1,IGDR) or ALT_COM_SWH_01 (E1)
27	RMS_SWH_Aux (J1,E1)	ALT_COM_SWH_02 (J1) or ALT_COM_SWH_01 (E1)
28	NVP_SWH_Aux (J1,E1)	ALT_COM_SWH_02 (J1) or ALT_COM_SWH_01 (E1)
29	Net_Inst_Corr_SWH_Aux (J1) (8)	ALT_MAN_COR_01 (J1,IGDR)
30	Sig0_Main (J1,E1) (9)	ALT_PHY_WIN_01

31	RMS_Sig0_Main (J1,E1)	ALT_COM_BAC_03
32	NVP_Sig0_Main (J1,E1)	ALT_COM_BAC_03
33	Net_Inst_Corr_Sig0_Main (J1) (10)	ALT_MAN_COR_01(J1,IGDR)
34	Corr_Atm_Att_Sig0_Main (J1,E1)	RAD_PHY_GEN_01(J1), RAD_PHY_ATT_01(E1)
35	AGC_Main (J1)	ALT_COM_BAC_01
36	RMS_AGC_Main (J1)	ALT_COM_BAC_01
37	NVP_AGC_Main (J1)	ALT_COM_BAC_01
38	Net_Inst_Corr_AGC_Main (E1)	ALT_MAN_COM_02
39	Sig0_Aux (J1,E1) (11)	ALT_PHY_WIN_01
40	RMS_Sig0_Aux (J1,E1)	ALT_COM_BAC_03
41	NVP_Sig0_Aux (J1,E1)	ALT_COM_BAC_03
42	Net_Inst_Corr_Sig0_Aux (J1) (12)	ALT_MAN_COR_01(J1,IGDR)
43	Corr_Atm_Att_Sig0_Aux (J1,E1)	RAD_PHY_GEN_01 (J1), RAD_PHY_ATT_01 (E1)
44	AGC_Aux (J1)	ALT_COM_BAC_01
45	RMS_AGC_Aux (J1)	ALT_COM_BAC_01
46	NVP_AGC_Aux (J1)	ALT_COM_BAC_01
47	Net_Inst_Corr_AGC_Aux (E1)	ALT_MAN_COR_02
48	Off_Angle_Wave_Main (J1,E1) (13)	ALT_COM_MIS_02
49	Off_Angle_Platform (J1,E1) (14)	PLA_PHY_MIS_01
50	Rad_BT1 (J1,E1) (15)	RAD_PHY_TEM_01(J1) or RAD_MAN_INT_01 (E1)
51	Rad_BT2 (J1,E1) (16)	RAD_PHY_TEM_01(J1) or RAD_MAN_INT_01 (E1)
52	Rad_BT3 (J1) (17)	RAD_PHY_TEM_01(J1)
53	MWR_Std_BT1 (E1)	RAD_MAN_INT_01 (E1)
54	MWR_Std_BT2 (E1)	RAD_MAN_INT_01 (E1)
55	Rad_Wind (J1)	RAD_PHY_GEN_01 (J1)
56	Rad_Water_Vapour_Content (J1,E1)	RAD_PHY_GEN_01 (J1), RAD_PHY_GEN_02 (E1)

57	Rad_Liquid_Water (J1,E1)	RAD_PHY_GEN_01 (J1), RAD_PHY_GEN_02 (E1)
58	MSS (J1,E1)	GEN_ENV_MSS_01
59	Geoid (J1,E1)	GEN_ENV_GEO_01
60	Ocean_D/L_Elevation (J1,E1)	GEN_ENV_BAT_01
61	Inv_Baro_Corr (J1,E1)	GEN_ENV_MET_02
62	Elastic_Ocean_Tide_1 (J1,E1)	GEN_ENV_TID_01
63	Elastic_Ocean_Tide_2 (J1,E1)	GEN_ENV_TID_02
64	Equ_Long_Period_Ocean_Tide (J1,E1)	GEN_ENV_TID_03
65	Mean_Sea_Surf_Pressure (J1,E1)	GEN_COR_RAN_01
66	Loading_Tide_Height_1 (J1)	GEN_ENV_TID_01
67	Loading_Tide_Height_2 (J1,E1)	GEN_ENV_TID_02
68	Solid_Earth_Tide (J1,E1)	GEN_ENV_TID_03
69	Pole_Tide (J1,E1)	GEN_ENV_TID_04
70	U_Wind (J1,E1)	GEN_COR_RAN_01
71	V_Wind (J1,E1)	GEN_COR_RAN_01
72	Alt_Wind (J1,E1)	ALT_PHY_WIN_01
73	Alt_TEC (J1,E1)	ALT_COR_RAN_12

(1) For Jason-1, this flag corresponds to the bit n°0 of the quality flag for the 1Hz altimeter data described in AD1.

(2) For Jason-1, this flag corresponds to the bit n°1 of the quality flag for the 1Hz altimeter data described in AD1.

(3) For Jason-1, this flag corresponds to the bit n°0 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1.

(4) For Jason-1, this flag corresponds to the bit n°1 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1

(5) For Jason-1, this flag corresponds to the bit n°2 of the quality flag for the 1Hz altimeter data described in AD1.

(6) For Jason-1, this flag corresponds to the bit n°2 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1.

(7) For Jason-1, this flag corresponds to the bit n°3 of the quality flag for the 1Hz altimeter data described in AD1.

(8) For Jason-1, this flag corresponds to the bit n°3 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1.

(9) For Jason-1, this flag corresponds to the bit n°4 of the quality flag for the 1Hz altimeter data described in AD1.

(10) For Jason-1, this flag corresponds to the bit n°4 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1

(11) For Jason-1, this flag corresponds to the bit n°5 of the quality flag for the 1Hz altimeter data described in AD1

(12) For Jason-1, this flag corresponds to the bit n°5 of the quality flag for the 1Hz instrumental correction on altimeter data described in AD1

(13) For Jason-1, this flag corresponds to the bit n°6 of the quality flag for the 1Hz altimeter data described in AD1

(14) For Jason-1, this flag corresponds to the bit n°7 of the quality flag for the 1Hz altimeter data described in AD1.

(15) For Jason-1, this flag corresponds to the bit n°0 of the quality flag for the 1Hz radiometer data described in AD1.

(16) For Jason-1, this flag corresponds to the bit n°1 of the quality flag for the 1Hz radiometer data described in AD1.

(17) For Jason-1, this flag corresponds to the bit n°2 of the quality flag for the 1Hz radiometer data described in AD1.

The flags corresponding to each parameter described in the previous table are grouped by families. The list of flags and families are given in Annex 1 of AD10.

In order to control the estimates of the final range (with all the corrections taken into account), the following combinations of parameters have to be controlled:

<u>For the main band:</u>

For JASON-1 and ENVISAT-1:

RES_SSH_MAIN = Relative altitude of the satellite - Relative_Main_Band_Range - Model_Dry_Trop_Cor - Model_Wet_Trop_Cor - Altimeter_Ionospheric_Corr_Main_Band - Sea_State_Bias_Corr_Main - Inverted_Barometer_Height_Corr - Elastic_Ocean_tide_height_Sol1 - Solid_Earth_Tide_Height - Equilibrium_Long_Period_Ocean_Tide_Height - Pole_Tide_Height - Mean sea surface height

The flag issued from this control is Flag_Res_SSH_Main described in Annexe 1 of AD10.

<u>For the auxiliary band:</u>

For JASON-1 and ENVISAT-1:

RES_SSH_AUX = Relative altitude of the satellite - Relative_Aux_Band_Range - Model_Dry_Trop_Cor - Model_Wet_Trop_Cor - Altimeter_Ionospheric_Corr_Aux_Band - Sea_State_Bias_Corr_Aux - Inverted_Barometer_Height_Corr - Elastic_Ocean_tide_height_Sol1 - Solid_Earth_Tide_Height - Equilibrium_Long_Period_Ocean_Tide_Height - Pole_Tide_Height - Mean sea surface height

The flag issued from this control is Flag_Res_SSH_Aux described in Annexe 1 of AD10.

Family flags are constructed as it has been described in 3.2.1 (2nd step) and correspond to the bitfields described in A1 of AD10.

As previously seen in section 3.2.1, general flags are then computed from family flags according to the following table (Flags listed in the first raw are obtained by the combination of the flags in the first column).

	Flag_Gen_Main		Flag_Gen_Aux		Flag_Gen_Other		Flag_Gen_Final	
	J1	E1	J1	E1	J1	E1	J1	E1
Flag_Fam_Range_Main								
Flag_Fam_Range_Aux								
Flag_Fam_Corr_Range								
Flag_Fam_SWH_Main								
Flag_Fam_SWH_Aux								
Flag_Fam_Sig0_Main								
Flag_Fam_AGC_Main								
Flag_Res_SSH_Main								
Flag_Fam_Sig0_Aux								
Flag_Fam_AGC_Aux								
Flag_Res_SSH_Aux								
Flag_Fam_Off_Angle								
Flag_Fam_Rad_BT								
Flag_Fam_Geoph_1								
Flag_Fam_Geoph_2								
Flag_Env_Par								
Flag_Gen_Main								
Flag_Gen_Aux								
Flag_Gen_Other								

Figure 3: Construction of the general flags from family flags

The percentages of “valid” and “invalid” data are computed with the values of these flags:

“Perc_Valid_Main” and “Perc_Non_Valid_Main” are computed with Flag_Gen_Main

“Perc_Valid_Aux” and “Perc_Non_Valid_Aux” are computed with Flag_Gen_Aux

“Perc_Valid_Other” and “Perc_Non_Valid_Other” are computed with Flag_Gen_Other

The general percentages of valid and invalid data are computed with Flag_Gen_Final: “Perc_Valid_Global” and “Perc_Non_Valid_Global”.

3.2.3. CONTROL OF THE DORIS TEC PARAMETERS

The controls defined in section 3.2.1 are also applicable to the DORIS TEC parameters at level 1b. The control processing specific to the DORIS TEC parameters is described hereafter:

The 1st and 4th steps of the control procedure are performed for the following list of parameters.

The list of parameters to be controlled is given below:

- TEC values at each output grid point, on the ascending grid and on the descending grid
- Covariance at each output grid point, on the ascending grid and on the descending grid

Generated Control flags:

- Flag_TEC for each output grid point, on the ascending grid and on the descending grid
- Flag_Cov_TEC for each output grid point, on the ascending grid and on the descending grid

The percentages of valid and invalid data for the TEC values, for the covariance values, on the ascending grid and on the descending grid are generated during the 4th step of the control procedure.

3.2.4. CONTROL OF THE CALIBRATION PARAMETERS FOR JASON-1

The controls defined in section 3.2.1 are also applicable to the calibration parameters. Due to POSEIDON-1 heritage, some of the parameters computed in the calibration procedure are controlled in the same time. The list of flags issued from the calibration procedure is given below. The list of parameters controlled by the specific control chain is also given below. The control processing specific to the generation of the LTM calibration file is given in section 3.3. The following table gives the flags entering in the computation of the 2 family flags + the general calibration flag.

	Flag_LPF	Flag_PTR	Flag_CAL
Control flags computed during the calibration procedure (AD2)			
Left_Mean_Flag_LPF			
Left_STD_FLAG_LPF			
Left_Diff_Flag_LPF			
Left_Slope_Flag_LPF			
Left_Std_Slope_Flag_LPF			
Right_Mean_Flag_LPF			
Right_STD_FLAG_LPF			
Right_Diff_Flag_LPF			
Right_Slope_Flag_LPF			
Right_Std_Slope_Flag_LPF			
Flag_Val_Filter			
Flag_Val_Corr_PTR			
Flag_Tot_Power			
Flag_Width_Main_Lobe			
Flag_Diff_Trav			
Flag_Freq_Med_PTR			
Flag_Sec_Lobe_PTR			
Flag_Estimation			
Control flags computed during the control procedure			
Flag_Freq_Max_LPF			
Flag_Val_FNT			
Flag_Std_Val_FNT			
Flag_Val_F1			
Flag_Std_Val_F1			
Flag_Val_F2			
Flag_Std_Val_F2			
Flag_Dist_Max_PTR			
Flag_LPF			
Flag_PTR			

Figure 4: Construction of family flags and general flags

Except the two last flags, all the flags in the first column are obtained by the 1st step defined in 3.2.1.

The 3 family flags corresponding to LPF, PTR and GEN are generated according the 2nd step defined in 3.2.1.

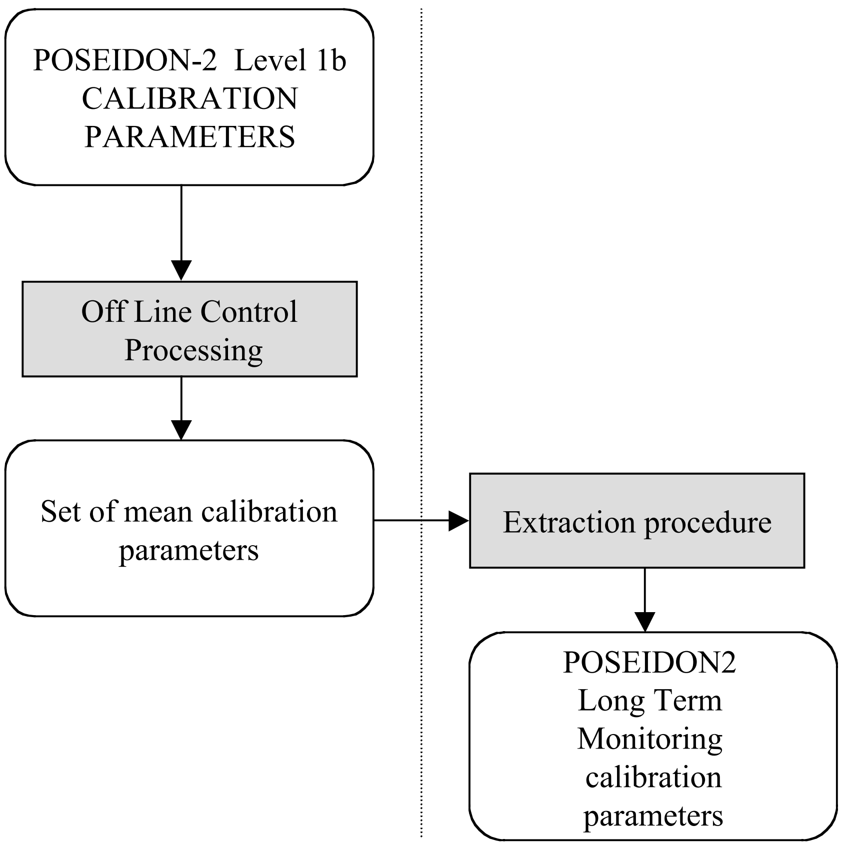
3.3. LONG TERM MONITORING FOR JASON-1

One of the aims of the control processing is to generate a "Long Term Monitoring" file of the instrument that sums up the evolutions of the components of the altimeter. This file is used in the OSDR and IGDR production chain and contains the averaged values for the day, of a subset of calibration (Ku 320, C320 and C100 bands) parameters:

- Samples of the filter, “thermal noise coefficient”, “P1 coefficient”, “P2 coefficient”, total power of the PTR, difference of travel between the emission and the reference lines.

For the calibration parameters, the computation of the statistical parameters (mean, std, min and max values) is performed using the algorithm “GEN_CTL_QUA_02 - To compute statistical parameters”. The computation of the filter used by the OSDR and IGDR production chain is performed using the algorithm “GEN_CTL_LTM_01 - To compute the mean filter of the day”. The data in input is produced by the level 1b calibration processing.

For each of these calibration parameters, a control flag is computed using the procedure described in the first step (Cf 3.2.1). Their names are Flag_LTM_Filter, Flag_LTM_TN, Flag_LTM_P1, Flag_LTM_P2, Flag_LTM_Tot_Power_PTR, Flag_LTM_Diff_Trav. A family flag **Flag_Fam_LTM** is then issued from these six flags.



The flowchart of the processing is given in Figure 3. The algorithms described in this document deal with the left part of this flowchart: computation of a set of calibration parameters. The generation of the external “LTM” file is described in TBD.

Figure 5: Flowchart of the generation of the LTM Calibration parameters

4. FUNCTIONS

A list of the functions of the Off Line control processing is given in figure 4.

APPLICABILITY			ALGORITHMS
JASON-1		JASON-1 and ENVISAT	
CAL	IONO TEC	Level2 Products (IGDR,GDR)	
■			GEN_CTL_LTM_01 - To compute the mean filter of the day
■	■	■	GEN_CTL_QUA_01 - To compress an array of flags
■	■	■	GEN_CTL_QUA_02 - To compute statistical parameters
■	■	■	GEN_CTL_QUA_03 - To determine percentages
■	■	■	GEN_CTL_QUA_05 - To edit data measurements using thresholds

Figure 4: functions of the Off Line Control Processing

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GEN_CTL_LTM_01 - To compute the mean filter of the day

DEFINITION, ACCURACY AND SPECIFICATION

Prepared by:	P.THIBAUT	
Approved by:	P. VINCENT	

Document ref:	4th July 2001	Issue: 2	Update: 2

Algorithm change record	Creation	Date	Issue:	Update:
	CCM			

HERITAGE

None

FUNCTION

To compute the mean filter of the day that will be written in the “Long Term Monitoring” file.

APPLICABILITY

JASON-1

ALGORITHM DEFINITION

Input data

- Computed data:
  - Number of filters
  - Number of samples of the filters
  - Values of the filters
  - Interval in frequency between two samples for each filter
- Dynamic auxiliary data: None
- Static auxiliary data:
  - POSEIDON-2 instrumental characterization data
    - ∗ Fine trigger delay resolution, depending on the emitted bandwidth: δt_{FTD} (in time) or δf_{FTD} (in frequency)
    - ∗ Normalized FIR filter, with a step equal to the fine trigger delay resolution

Output data

- Samples of the mean filter
- Validity flag

Mathematical statement

In the level 1b processing chain, the filter needed to correct the waveforms for the filtering effects is the mean filter of the CAL2 calibration sequences of the day in each Ku, C320 and C100 band. This algorithm is aimed at interpolating the filters, at the fine trigger resolution δf_{FTD} and also at averaging the filters of the day.

For each band (Ku320, C320 and C100), the filter f issued from the internal calibration processing represents the on-board measurement of the product of two filters:

$$f = f_{FI2}.f_{FIR}$$

The FIR filter f_{FIR} is a numerical filter constant during the whole mission, which may be characterized with a step equal to the fine trigger delay resolution δf_{FTD}. This filter is the input POSEIDON-2 instrumental characterization data. It does not depend on the emitted frequency. The FI2 filter (f_{FI2}) is an analogical filter, which may vary during the mission.

Because of the duration of the on-board calibration process, the step δf_{filter} of the measured filter will be greater than the fine trigger resolution δf_{FTD} (e.g. δf_{filter} corresponding to 1 or 1/8 or 1/16 or 1/32 FFT sample, instead of 1/64 FFT sample for δf_{FTD}).

In order to be able to determine the effects of the filtering on each pulse of a waveform (see AD2: To correct the waveforms for the filtering effects), the filter f is given at the nominal sampling rate.

The procedure is summed up on the following figure:

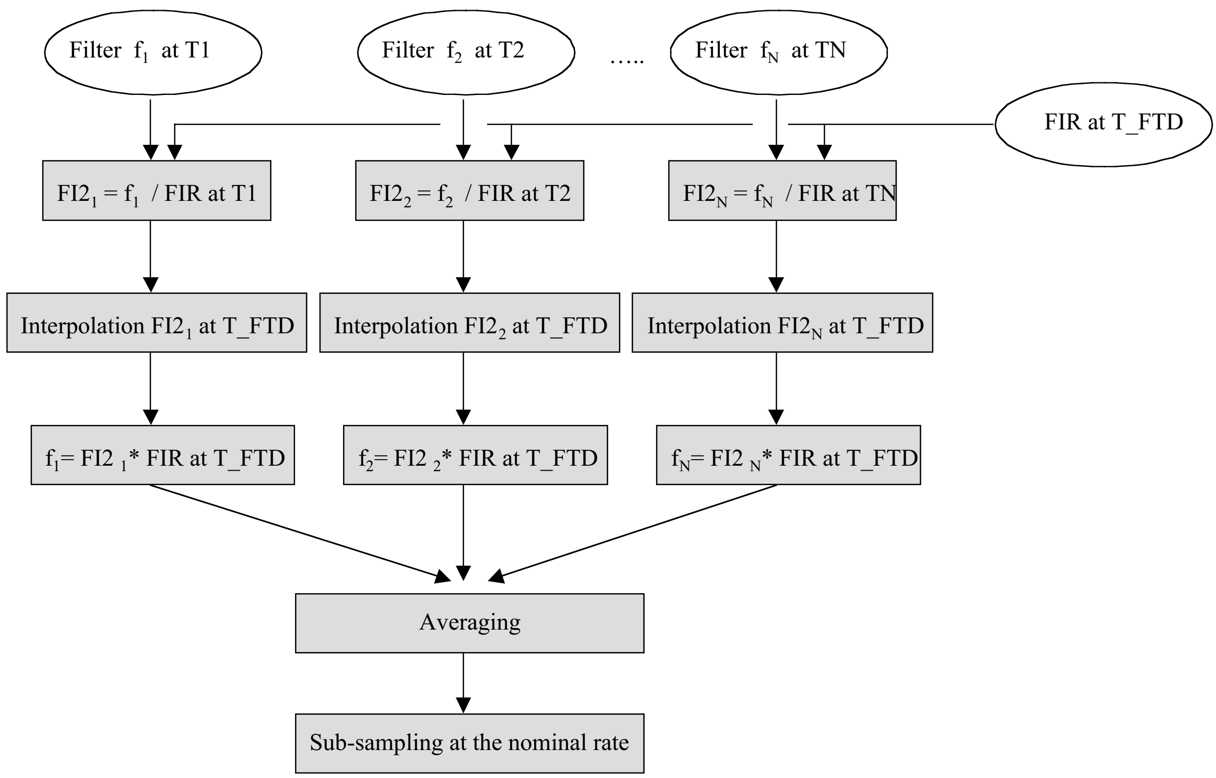

Figure 1: Flowchart of the procedure

The main steps of the procedure are:

- Restoration of the FI2 filter from f, with the same step δf_{filter}:

$$f_{FI2} = \frac{f}{f_{FIR}} \quad (\text{step } \delta f_{filter})$$

- Linear interpolation of this f_{FI2} filter with a step equal to δf_{FTD}
- Multiplication of the over-sampled FI2 filter by the FIR filter:

$$f = f_{FI2} . f_{FIR} \quad (\text{step } \delta f_{FTD})$$

- Averaging of the filters measured on the day to obtain f
- Sub-sampling the filter in order to obtain a filter with the right number of samples

ALGORITHM SPECIFICATION

Warning: The filters that are averaged are selected by the “data management algorithms” (AD8) depending on the result of the control processing. Only the filters that are declared OK by the control processing are averaged to generate the LTM calibration parameters.

Input data

- Number of filters : Num_Filter (/)
- Number of samples of the measured filters : Num1 [0:Num_Filter-1] (/)
- Samples of the filters : Filter_In $_j$ [0:Num1(i)-1] j=0..Num_Filter-1 (/)
- Number of samples of the filter at the fine trigger resolution : Num2 (/)
- Numerical filter (FIR) at the fine trigger delay resolution : FIR_FTD [0:Num2-1] (/)
- Interval in frequency between two samples of the filters : T[0..Num_Filter-1] (Hz)
- Interval in frequency between two samples of the filters at the fine trigger delay resolution : T_FTD (Hz)
- Number of samples of the filter in output : Num3 (/)

Output data

- Samples of the mean filter of the day : Filter_Out [0:Num3-1] (/)
- Validity flag of the mean filter : Val_Filter_Out (/) [(1)]
- Execution status

[(1)] 2 states : “valid” and “invalid”

Processing

For the j^{th} filter f:

- The first step is to correct each filter for the effects of the FIR.
  - Restoration of the analogical FI2 filter from the f filter at the step of T(j):

$$FI2_j(i) = \frac{Filter\_In_j(i)}{FIR\_FTD\left(i * NINT\left[\frac{T(j)}{T\_FTD}\right]\right)} \quad \text{for i=0 to Num1(j)-1} \qquad (1)$$

Note: NINT is defined as the "Nearest INTeger" mathematical function.

- The second step consists of over-sampling it to the fine trigger delay resolution
  - Linear interpolation of $FI2_j$ to a step equal to T_FTD:

    The linear interpolation is computed using the algorithm (AD5): "GEN_MEC_INT_05 – Interpolation of an array at a new sampling frequency" with the following inputs:

    * Number of samples of the array in input : Num1(j) (/)
    * Interval (in freq) between two samples of the array in input : T(j) (Hz)
    * Index associated with the zero frequency of the input array : Num1(j)/2 + 1 (/) (1)
    * Samples of the input array : $FI2_j$ [0:Num1(j)-1] (/)
    * Interval (in frequency) between two samples of the output array : T_FTD (Hz)

    The outputs of the interpolation are:

    * Samples of the filter at the new sampling frequency : $FI2\_FTD_j$ [0:Num2-1] (/)
    * Index associated with the zero frequency of the array in output : F0_Out_Filter (/)
    * Number of samples of the output array : Num2 (/)

- The third is the multiplication of the over-sampled filter $FI2\_FTD_j$ by the numerical filter FIR_FTD:

$$F\_Out_j(i) = FI2\_FTD(i) * FIR\_FTD(i) \quad \text{for i=0 to Num2-1} \qquad (2)$$

When all the F_Out_j of the day have been computed:

- The fourth step of the processing is to average the Num_Filter filters F_Out_j in input according to the following formula:

(1) The 0-frequency point is the $(Num1(j)/2 + 1)^{th}$ point of the array.

$$Filter\_Out(i) = \frac{1}{Num\_filter} \sum_{j=0}^{Num\_Filter-1} F\_Out_j(i) \quad \text{for i=0 to Num2-1} \tag{3}$$

- The last step consists in sub–sampling the resulting filter in order to obtain a filter at the nominal rate which can be used by the Level1b processing chain.

$$Filter\_Out(i) = Filter\_Out(i * \frac{Num2}{Num3}) \quad \text{for i=0 to Num3-1} \tag{4}$$

- If the mean filter is generated, the validity flag Flag_Filter_Out is set to “valid”. It has been initialized to “invalid”.
- If Num_Filter=0, the mean filter is not generated. Val_Filter_Out is set to “invalid” and the samples of Filter_Out are set to default values.

ACCURACY

None

COMMENTS

- C-band waveforms consist of 128 samples if the emitted bandwidth is 320 MHz, and 40 samples if the emitted bandwidth is 100 MHz. So the filter that is expected in the level1b processing to correct to waveforms is a filter given with the expected number of samples. The number of samples of the filters in input is taken into account by the data management algorithms. The operations that are performed in this algorithm do not presume of the length of the filters and the FIR filters in input are given with the expected number of samples.
- In the nominal calibration scenario, the filters acquired during the day have the same number of samples (they are computed at the same nominal sampling frequency). In this case, the array T(j) with j from 0 to Num_filter-1 is uniform ie T(j) = T(i) for all i and j. It is then possible to perform first the fourth step of the algorithm and then the three initial steps applied on the mean filter to reduce the computational time.
- In the LTM file, the filter will be written only if the filter can be used (non-default values). In the level 1b production algorithms, if the results of calibration for one day cannot be found the last “valid” day is taken into account.

REFERENCES

None

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31401 TOULOUSE CEDEX 4

GEN_CTL_QUA_01 - To compress an array of flags

DEFINITION, ACCURACY AND SPECIFICATION

Prepared by:	P. THIBAUT	
Approved by:	P. VINCENT	

Document ref:	4th July 2001	Issue: 2	Update: 2

Algorithm change record	Creation	Date	Issue:	Update:
	CCM			

HERITAGE

None

APPLICABILITY

JASON-1 and ENVISAT

FUNCTION

To compress an array of flags.

ALGORITHM DEFINITION

Input data

- Product data :
  - Number of flags to compress (length of the array of flags)
  - Array of flags
- Computed data : None

Output data

- Flag

Mathematical statement

The aim of this algorithm is to compress an array of flags in order to obtain an unique flag that sums up the array.

ALGORITHM SPECIFICATION

Input data

- Number of flags to compress : N (/)
- Flags : Flag_In [0:N-1] (/) (1)

(1) 2 states : “valid” and “invalid”

Output data

- Flag that sums up the input array of flags : Flag_Out (/)[(1)]

Processing

This function is performed using the mechanism "GEN_MEC_COM_06 – Flag compression" (AD5).

The inputs are:

- Number of flags to check : N (/)
- Flags to check : Flag_In[0:N-1] (/) [(1)]

The outputs are:

- Flag that sums up the array of flags : Flag_Out (/) [(1)]

ACCURACY

None

COMMENTS

None

REFERENCES

None

[(1)] 2 states : "valid" and "invalid"

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GEN_CTL_QUA_02 - To compute statistical parameters

DEFINITION, ACCURACY AND SPECIFICATION

Prepared by:	P. THIBAUT	
Approved by:	P. VINCENT	

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Algorithm change record	Creation	Date	Issue:	Update:
	CCM			

HERITAGE

None

FUNCTION

To compute statistical parameters of an array in input

APPLICABILITY

JASON-1 and ENVISAT

ALGORITHM DEFINITION

Input data

- Product data :
  - Values of the parameter
  - Number of values
  - Quality flag of the parameter
- Computed data : None
- Static auxiliary data: None

Output data

- Averaged parameter
- Extremum values of the parameter (Min and Max)
- Standard deviation of the parameter
- Quality flag on the averaged parameter

Mathematical statement

The aim of this algorithm is to compute the statistical characteristics of the array of valid data in input. The first step is to check the valid data and the second step is to compute mean, standard deviation and extremum values of the array.

ALGORITHM SPECIFICATION

Input data

- Number of values of the parameter : Num (/)
- Values of the parameter : X [0:Num-1] (1)
- Quality flags of the parameter : Flag_X [0:Num-1] (/) (2)

Output data

Statistic parameters for the temperature in input

– Mean value : Mean_X (1)
– Standard deviation : Std_X (1)
– Minimum value : Min_X (1)
– Maximum value : Max_X (1)
– Execution status

Processing

The aim of this algorithm is to compute the 4 main statistical parameters for a vector given in input (mean, standard deviation, minimum and maximum values). These characteristics are computed for parameters that have a validity flag set to “valid”.

Mean, standard deviation, minimum and maximum values are computed according to the mechanism “GEN_MEC_COM_01 - Arithmetic averaging” in AD5. The inputs are:

– Number of points : Num1 (/)
– Array of values : X [0:Num1-1] (1)

The ouputs are:

– Mean value : Mean_X (1)
– Standard deviation : Std_X (1)
– Minimum value : Min_X (1)
– Maximum value : Max_X (1)

ACCURACY

None

---

(1) The unit depends on the parameter in input

(2) 2 states : “valid” and “invalid”

COMMENTS

- This algorithm is used to compute the mean value of the calibration characteristics that are given in the LTM calibration file.

REFERENCES

None

Affaires Techniques Projets et Services Opérationnels
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GEN_CTL_QUA_03 - To determine percentages

DEFINITION, ACCURACY AND SPECIFICATION

Prepared by:	P. THIBAUT	
Approved by:	P. VINCENT	

Document ref:	4th July 2001	Issue: 2	Update: 2

Algorithm change record	Creation	Date	Issue:	Update:
	CCM			

HERITAGE

None

FUNCTION

To determine percentages of each state of flag in an array of flags

APPLICABILITY

JASON-1 and ENVISAT

ALGORITHM DEFINITION

Input data

- Product data :
  - Number of flags in a flag array
  - Flag array
  - Number of states of the flag
- Computed data : None
- Static auxiliary data: None

Output data

- Percentages of each state of the flag (P_i)

Mathematical statement

The aim of this algorithm is to compute the percentages of each state of the flag array.

ALGORITHM SPECIFICATION

Input data

- Number of flags (length of the flag array) : Num_Flag (/)

- Flag array : VF [0:Num_Flag-1] (/) [(1)]
- Number of states of the flag : Num_State (/)

Output data

- Number of flags for each state : N [0:Num_State-1] (/)
- Percentages of each state of the flag array (P_i) : Perc [0:Num_State-1] (/)

Processing

The aim is to compute the Num_State percentages of the states of the flag array.

For the i^{th} state of the flag array:

- the number of flags of the flags array which are set to the i^{th} state : N(i)
- The percentage of the flags set to the i^{th} state according to the next formula:

$$\mathrm{Perc}(i) = \frac{N(i) * 100}{\mathrm{Num\_Flag}} \tag{1}$$

ACCURACY

None

COMMENTS

None

REFERENCES

None

(1) "Num_State" states.

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GEN_CTL_QUA_05 - To edit data measurements using thresholds

DEFINITION, ACCURACY AND SPECIFICATION

Prepared by:	P.THIBAUT	
Approved by:	P. VINCENT	

Document ref:	4th July 2001	Issue: 2	Update: 2

Algorithm change record	creation	date	Issue:	Update:
	CCM			

FUNCTION

To edit the data measurements for which the value of some particular field (or linear combination of some particular fields) is not comprised between upper and lower threshold values.

ALGORITHM DEFINITION

Input data

- Product data:
  - All the parameters to be checked.
- Computed data:
  - Validity flag (VF)
- Dynamic auxiliary data: None
- Static auxiliary data:
  - For each field (or linear combination of fields) to be checked:
    - Its lower and upper threshold values

Output data

- For each parameter :
  - Validity flag (VF)

Mathematical statement

The processing is performed only if the validity flag of the parameter (VF) is set to “valid”.

- For each parameter in input :
  - For each of the fields or for each linear combination of fields to be checked (given in the command file):
    - If its value is lower than the lower threshold or greater than the upper threshold, then:
      - ◊ the validity flag of the input parameter (VF) is set to “invalid”.

ALGORITHM SPECIFICATION

Input data

- Number of parameters to be checked : Nb_Params (/)
- Total number of fields : Nb_Fields (/)

- Fields : Fields[0:Nb_Fields-1] (1)
- The validity flags of the parameters : VF[0:Nb_Params-1] (/) (2)
- For each parameter to be checked (For I_Param = 0 to Nb_Param-1)
  - The number of fields within the measurement, from which the parameter is computed : Nb_FieldsParam [0:Nb_Params-1] (/)
  - For each field (for I_Field = 0 to Nb_Fields-1)
    - ∗ The field number from which the parameter is computed : Num_Field [0:Nb_Params-1][0:Nb_Fields-1] (/)
    - ∗ The sign of each field when computing the parameter from their linear combination : Sign [0:Nb_Params-1][0:Nb_Fields-1](/)(3)
  - Its lower threshold value : Thresh_Inf[0:Nb_Params-1] (1)
  - Its upper threshold value : Thresh_Sup[0:Nb_Params-1] (1)

Output data

- The validity flags of the parameters : VF[0:Nb_Params-1] (/) (2)

Processing

The editing of the input parameters is performed thanks to the mechanism “GEN_MEC_QUA_03 – Editing of measurements against thresholds” (AD5), the input parameters of which are the above described input data, and the output parameters of which are the above described output data with some particular values:

In input, Nb_Mes is set to 1 and Nb_Params are set to 1.

In output, the three last numbers are unused.

ACCURACY

None

COMMENTS

- For the control of the IGDR or GDR parameters, the VF in input is issued from the “Over-flown surface flag” of the altimeter measurements.

---

(1) the unit depends on the parameter in input

(2) 2 states : “valid” and “invalid”

(3) “plus” or “minus”

For Jason-1, VF will be set to “valid” if the “Over-flown surface flag” is set to “ocean”.

For Envisat, VF will be set to “valid” if the “Over-flown surface flag” is set to “ocean” or ”continental ice”.

REFERENCES

None

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